

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
15 May 2003 (15.05.2003)

PCT

(10) International Publication Number  
**WO 03/039248 A1**

(51) International Patent Classification<sup>7</sup>: **A01K 63/00**,  
E02D 31/00

(21) International Application Number: PCT/GB01/04991

(22) International Filing Date:  
9 November 2001 (09.11.2001)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **POND CARE LTD.** [GB/GB]. 222 Park Road, Timperley, Altrincham, Cheshire WA15 6QY (GB).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **ALTON, Robert, Herbert** [GB/GB]. 222 Park Road, Timperley, Altrincham, Cheshire WA15 6QY (GB).

(74) Agents: **HACKNEY, Nigel, J. et al.**; Mewburn Ellis, York House, 23 Kingsway, London WC2B 6HP (GB).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

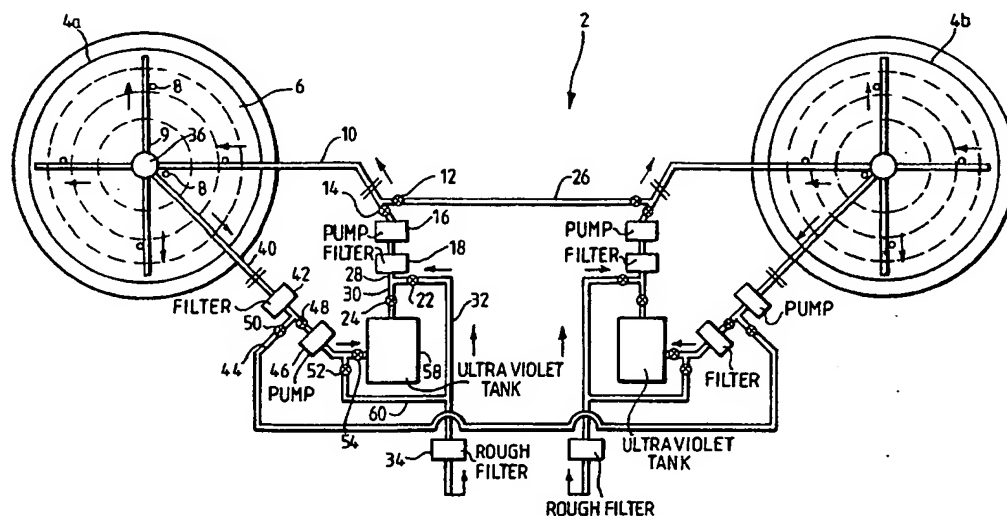
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report

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(54) Title: A POLYMERIC LINER



(57) Abstract: The invention relates to the use of a liquid polymer resin composition as a pond liner. The invention also relates to ponds including such liners and methods of constructing such ponds. The ponds are suitable for prawn farming. A pond is constructed by excavating a pit. A layer of support material, e.g. concrete, is applied to the walls of the pit. An intermediate woven material is applied to the concrete layer. Subsequently, a liquid polymer resin composition is spray-coated onto the intermediate woven material. The composition cures to form a polymer lining. The pond includes one or more vent pipes located in the base portion of the pond in order to prevent a build-up of gas underneath the pond liner. The pond has associated treatment apparatus including, for example, a filtration apparatus, pumps, purification apparatus and various conduits.

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WO 03/039248 A1

A POLYMERIC LINER

The present invention relates to the use of liquid polymer resin compositions as liners for receptacles capable of containing liquids, receptacles including such liners and methods of producing the receptacles. In a particular, but not exclusively, the present invention relates to the use of the liquid polymer resin composition as a pond liner, ponds including such liners and methods of constructing such ponds.

Small ponds are well known as ornamental water features in for example residential gardens. Such ponds typically include a pre-formed polymeric liner membrane to prevent the water in the pond draining away through the soil and to prevent contaminants that may be present in the soil from leeching into the pond water. On a much larger scale, ponds are used in the farming of marine and fresh water animals, for example prawns.

Typically these commercial farming ponds have a surface area of about one acre and do not include any form of polymeric liner. Instead, the pond is simply prepared by excavating the desired shape and volume, filling it with either fresh water or brine, adding the prawn fry, feeding the fry and allowing them to mature, draining out the water and digging out the remaining mature prawns from the bottom of the pond. This conventional method typically leads to a 70 to 80% loss of harvest based on the numbers of fry introduced into the pond.

One reason for the poor survival rate of the fry and young prawns is thought to be due to contaminants leeching into the pond water from the soil or the contamination of the water by airborne pollutants. It is not possible to

filter or purify the water as any filtration apparatus would quickly become blocked or clogged by soil.

Additionally, commercial farming ponds also suffer the problem of soil erosion which produces a silt at the bottom of the pond and results in an effective decrease in the volume of the pond.

In an attempt to improve the efficiency of commercial prawn farm ponds, a method of lining commercial ponds has been tried. Commercially available lengths of pre-formed pond liner have been welded together to provide a liner having the desired surface area and this used to line a farm pond. However, small pockets of gas are slowly but continuously released from the soil substrate. In the context of the relatively large surface area of a commercial prawn pond, a relatively large volume of gas is released over a period of time. This gas becomes trapped between the soil substrate and the welded pre-formed liner and the build up of this gas causes an increase in the tension in the liner, until eventually the tension becomes such that the welds between the liner elements fail, causing the liner itself to fail and cease to be effective.

It is an aim of the present invention to overcome or ameliorate at least some of the problems associated with the known liners.

According to a first aspect of the present invention there is provided a use of a liquid polymer resin composition in the manufacture of a receptacle capable of containing a liquid, wherein the liquid resin composition is applied to the interior surfaces of the receptacle and allowed or caused to cure to provide a receptacle having an interior polymer lining. The liquid resin composition is

preferably applied to the receptacle by spray coating.

The liquid contained within the receptacle is preferably water and may be brine or fresh water.

The receptacle preferably includes a treatment apparatus comprising for example a filtration apparatus. However, the receptacle may form part of a receptacle system which includes the receptacle and a treatment apparatus, e.g. a filtration apparatus, located outside of the receptacle wherein liquid from the receptacle is transported to and from the external treatment apparatus via one or more conduits. In a preferred embodiment, the receptacle or the receptacle system includes one or more pumps to pump the receptacle liquid through the treatment apparatus. The treatment apparatus may further include a purification apparatus to purify the liquid, for example by killing bacteria or other organic organisms therein. Preferably, the purification apparatus is located outside of the receptacle and includes a UV light source.

By the term "receptacle system", it is meant an apparatus comprising the receptacle together with additional associated components which may be used in conjunction with the receptacle, for example a treatment apparatus.

The receptacle is preferably a pond and thus a second aspect of the present invention provides a use of a cured, spray-coated liquid polymer resin composition as a pond liner. Preferably the pond is suitable for prawn farming.

In order to prevent a build up of gases between the substrate defining the pond and the pond liner, the pond preferably includes one or more vent pipes, preferably located in a base portion of the pond, wherein the joint

between the e.g. base portion of the pond and the vent pipe is sealed by the polymer composition.

The polymer composition is preferably a polyurethane since polyurethanes are relatively cheap commercially available polymers, they have the capability to be spray coated onto a substrate, and they cure to form a durable, tough, non-toxic layer. Where the desired polymer composition is a polyurethane-based composition, the liquid polymer resin includes a polyol component, and isocyanate component and optionally a catalyst. In a more preferred embodiment, the polyol component includes at least one polyether polyol.

Preferably the pond includes a means for generating a cyclical current. This drives the water to circulate which assists in the aeration of the water and provides a more natural environment for the young aquatic animals.

The pond may include a layer of an intermediate material between the pond-defining substrate and the polymeric liner. The intermediate material may have a web-like configuration. Preferably, the intermediate material is a woven fabric material. In certain embodiments, the intermediate material may be a hessian material. Alternatively, the intermediate material may be a woven synthetic material, e.g. a woven polyester or a woven polyamide material.

According to a third aspect of the present invention, there is provided a receptacle for containing a liquid, the receptacle including one or more interior or inwardly facing surfaces having thereon a liner comprising a spray-coated polymeric layer. The receptacle may be a pond and may also include any of the preferred features described above with respect to the first and second aspects of the

invention. The receptacle may have an internal surface area of at least  $500\text{m}^2$ , preferably at least  $1000\text{m}^2$  and more preferably at least  $4000\text{m}^2$ .

According to a fourth aspect of the present invention there is provided a method of manufacturing a receptacle capable of containing a liquid, the method including constructing a receptacle body having a base portion and at least one side wall portion, applying a layer of a liquid polymer resin composition to the inwardly facing surfaces of the base portion and the at least one side wall portion of the receptacle, and allowing or causing the resin composition to cure to provide a solid polymer liner on the inwardly facing surfaces of the receptacle.

The receptacle is preferably a pond and the method of constructing the pond preferably includes excavating a pit having a desired configuration, which is preferably circular, but other shapes are of course possible. If the pond has a circular cross-section, then a base portion and one side wall portion, the base portion and the side wall portion being defined by the substrate from which the pit was excavated, e.g. soil or earth.

A layer of a support material, for example a concrete layer may be applied to the e.g. soil substrate prior to the application of the liquid polymer resin composition.

The at least one side wall portion preferably slopes outwardly from the base portion to provide a receptacle having at least one sloping side wall portion.

Where the receptacle is a pond, one or more vent pipes may be sunk into the base portion of the pond prior to the liquid polymer resin composition being applied. The vent pipes are preferably arranged such that a first end of the

vent pipe is in communication with the soil substrate and a second end of the vent pipe is higher than the desired water level of the pond. The second end of the vent pipe is preferably curved to prevent the ingress of precipitation into the vent pipe. The liquid polymer resin composition is applied such that the joint between the vent pipe (where present) and the pond base portion is preferably sealed by the polymer composition.

The method preferably further includes the step of locating an intermediate material between the receptacle body and the polymer composition. The intermediate material is preferably a woven fabric material and/or has a web-like structure. The intermediate material may be a hessian material, but more preferably is a woven synthetic material such as a woven polyester fabric or a woven polyamide fabric. The intermediate material preferably has the effect of improving the adhesion between the polymeric liner composition and the receptacle-defining substrate(s).

The liquid polymer resin composition is preferably applied by spraying to form a spray-coated resin layer.

The resin of the fourth aspect of the invention is preferably a polyurethane resin as defined above.

Where the receptacle is a pond, the method preferably further includes the step of connecting to the pond, via one or more conduits, a filtration apparatus and/or pumps and/or a purification apparatus as described above. Thus, a method of manufacturing a receptacle system is also included within the fourth aspect of the present invention.

A fifth aspect of the present invention provides a method of reconditioning a previously contaminated pond,

the method comprising applying a layer of a liquid polymer resin composition to the interior surfaces of the pond and allowing or causing the resin composition to cure to provide a pond having a solid polymer liner thereon. This method allows existing ponds which can no longer be used owing to, for example, earlier farming methods which have left the pond-defining soil substrate contaminated, to be reused. This of course avoids the costly and time consuming procedure of actually digging out or excavating a new pond.

The preferred features described above with respect to the fourth aspect of the present invention apply equally to the fifth aspect of the present invention.

An embodiment of the present invention will now be described by way of example only with reference to the accompanying drawings in which:-

Figure 1 shows a schematic plan view of a pond system according to the present invention;

Figure 2 is a sectional view through a portion of one of the ponds shown in Figure 1;

Figure 3 is a sectional view through one of the vent pipes shown in Figure 1; and

Figure 4 is a perspective view of a central hub portion of one of the ponds shown in Figure 1.

Figure 1 shows a pond system 2 comprising two ponds 4a, 4b and their associated treatment apparatus, comprising pump, filtration and purification apparatus.

Since the two ponds 4a, 4b operate in the same way,



the operation of only pond 4a will be described below; the operation of pond 4b is substantially identical, using corresponding components and conduits for its treatment apparatus.

Water 6 is continuously extracted from the pond 4a, cycled through the treatment apparatus and reintroduced back into the pond 4a. The water is drawn from a central hub 36 of the pond 4a by a pump 46 via a conduit 40 and a filter 42. From the pump 46 the water is pumped into a purification tank 58 via a conduit 56. The purification tank 58 includes a plurality of ultra violet light sources (not shown) to purify the water passing therethrough. After purification, the water may be mixed with incoming fresh water introduced from a conduit 32 via a filter 34. The incoming fresh water is controlled by a valve 22 and this make-up water may be introduced to replace water lost through evaporation from the pond. The conduit 32 terminates a T-junction of which one arm of the T is formed by a conduit 30 which is the output conduit from the purification tank 58 and the other arm of the T is formed by a conduit 28 which carries purified water from the purification tank 58 and/or make-up water from the conduit 32 through a filter 18 to a pump 16. The pump 16 pumps the purified water and/or the make-up water back into the pond 4a via a conduit 10. The conduit 10 is in communication with a conduit 9 such that the two conduits 9, 10 are arranged in a cruciform configuration whereby the four arms of the cross extend radially outwards from the centre of the pond 4a and each arm is substantially perpendicular to its neighbouring arms.

If desired, the water taken from the pond 4a may be diverted via conduit 60 so that it does not pass through the purification tank 58. Valves 52, 54 control the flow of

water. If valve 54 is closed and valve 52 is open, then the water from the pond 4a passes via a conduit 60 into the conduit 32 containing the make-up water (i.e. it by-passes the purification tank 58). Conversely, if valve 54 is open and valve 52 is closed, then the water from the pond 49 will pass through the purification tank 58. A further valve 24 is used to control the flow of water exiting the purification tank 58. It may be desirable to have the water by-pass the purification tank 58, if, for example, one or more of the UV light sources needs to be replaced.

Additionally, for maintenance and/or repair reasons, both ponds 4a, 4b can be treated using just one of the respective treatment apparatus. Thus, valves 48, 50 are provided so that if necessary, the water from pond 4a can be diverted via a conduit 44 to the treatment apparatus associated with the pond 4b. A conduit 26 and further valves 12, 14 are provided to enable purified and/or make-up water from the treatment apparatus of pond 4b to be pumped into the pond 4a. Similarly, if repair or maintenance work is needed on the treatment apparatus associated with the pond 4b, the water from the pond 4b can be treated using the treatment apparatus associated with the pond 4a, by passing the water in the reverse direction through the conduits 44 and 26, with the appropriate configuration of the valves 12, 14, 48, 50 (and the corresponding valves in the treatment apparatus associated with the pond 4b).

Figure 2 shows a sectional view through a portion of the pond 4a. The pond 4a is constructed by excavating a pit having the desired dimensions so that the remaining soil substrate 72 defines a pond based portion 5 and a pond side wall portion 7. Once the pit has been excavated, a woven hessian material is arranged to cover the inwardly facing

or interior surfaces of the pond base portion 5 and the pond side wall portion 7. The hessian material may be affixed in position if desired. A liquid polyurethane resin composition is then spray coated onto the hessian intermediate layer and allowed to cure. The polyurethane resin is more specifically a polyether urethane composition commercially available from Baxenden Speciality Chemicals, Lancashire, UK, under the trade name Castomer 5060. The resin includes a catalyst and cures at room temperature (i.e. about 20°C) after about 24 hours. The liquid resin is applied such that a 2mm thick layer 70 of the cured polymer is obtained as the pond liner.

Castomer 5060 is a polyether urethane. It has two components, A and B. Component A is Castomer 5060 isocyanate, which is a quasi-prepolymer based on 4,4 diphenylmethane diisocyanate (MDI). Component B is Castomer 5060 resin, which is a blend of high grade polyether polyols and catalyst.

Figure 2 also shows a sectional view through the conduit 10 which is supported by a plurality of support elements 82 such that it is spaced apart from the pond base portion 5. Each support element 82 is located on the cured pond liner 70 and is retained in place by having applied to a base portion of the support element 82 and the cured pond liner, a further retaining layer (not shown) of the polyurethane resin which is then allowed to cure. The portion of the conduit 10 (and also the conduit 9, which is not shown in Figure 2) which in use is submerged under the water 6 includes a plurality of apertures 84 through which is ejected the water being pumped through the conduit 10. The apertures 84 in the conduit 10 are arranged such that the water ejected from them generates a cyclical current in the pond 4a which is shown more clearly in Figure 4.

Prior to spray coating the polyurethane resin, vent pipes 8 are located in the pond substrate 72, as shown in Figure 3. The vent pipes comprise a substantially straight elongate tube having a curved portion 74 at one end, the curved portion ending in a first opening 76. At the other end of the vent pipe 8 is a second opening 78 which is in communication with the soil substrate 72 and allows gas pockets in the soil substrate 72 to enter the vent pipe 8 via the second opening 78 and be exhausted from the vent pipe via the first opening 76. The curved portion 74 prevents ingress of rain or other precipitation into the vent pipe 8. The junction 80 between the vent pipe 8 and the soil substrate 72 is sealed by the polyurethane polymer layer 70 which is applied to the vent pipe from the junction 80 up to a height which is above the maximum water level of the pond.

Figure 4 shows an schematic view of the central hub portion of the pond 4a. The central hub member 36 supports the junction between the conduits 9 and 10. Each of the two conduits 9, 10 include the plurality of apertures 84 arranged to generate the cyclical current in the pond. The effect of the current generated by the water being ejected from the apertures 84, together with the suction of the water through the conduit 40 by the pump 46 draws water, together with any solid contaminants present it, into the central hub element 36 via four elongate apertures 88 in the side wall portion of the hub element 36. This assists in transporting foreign matter from the pond into the treatment apparatus via the central hub and the conduit 40. The treatment apparatus is set-up such that it treats the entire pond water 6 every 24 hours.

The prawn fry which are introduced into the embodiment

of the pond described in detail above are introduced when they are approximately thirty one days old (i.e. thirty one days post-hatching). At this age, they are capable of swimming against the relatively weak current which is generated in the pond 4a and as such, they are not typically sucked into the treatment apparatus and killed. However, if it is desired to introduce smaller or younger fry into the pond, then a filter (e.g. a 26 $\mu$ m filter) may be included in the pond to prevent the fry entering the treatment apparatus.

These preferred embodiments have been described by way of an example and it will be apparent to those skilled in the art that many alterations can be made that are still within the scope of the invention.

Claims

1. A method of manufacturing a receptacle capable of containing a liquid, the method including constructing a receptacle body having a base portion and at least one side wall portion, applying a layer of a liquid polymer resin composition to the inwardly facing surfaces of the base portion and the at least one side wall portion of the receptacle, and allowing or causing the resin composition to cure to provide a solid polymer liner on the inwardly facing surfaces of the receptacle.
2. A method according to claim 1 wherein the receptacle is a pond, and the method of constructing the pond includes excavating a pit having a desired configuration, the base portion and the at least one side wall portion being defined by the substrate from which the pit was excavated.
3. A method according claim 2 wherein the at least one side wall portion slopes outwardly away from the base portion to provide a receptacle having at least one sloping side wall portion.
4. A method according to claim 2 or claim 3 wherein a support material is applied to the substrate prior to the application of the liquid polymer resin composite.
5. A method according to any one of claims 2 to 4 wherein one or more vent pipes are sunk into the base portion of the pond prior to the liquid polymer resin composition being applied.
6. A method according to claim 5 wherein the one or more vent pipes are arranged such that a first end of the one or more vent pipes is in communication with the substrate and

a second end of the one or more vent pipes is higher than the desired water level of the pond.

7. A method according to claim 6 wherein the second end of the one or more vent pipes is curved to prevent the ingress of precipitation into the one or more vent pipes.

8. A method according to any one of claims 5 to 7 wherein the liquid polymer resin is applied such that a joint between the vent pipe and the pond base portion is sealed by the polymer composition.

9. A method according to any one of claims 1 to 8 further including the step of locating an intermediate material between the receptacle body and the polymer composition.

10. A method according to claim 9 wherein the intermediate material is a woven fabric material.

11. A method according to any one of claims 1 to 10 wherein the liquid polymer composition is applied by spraying to form a spray-coated resin layer.

12. A method of reconditioning a previously contaminated pond, the method comprising applying a layer of a liquid polymer resin composition to interior surfaces of the pond and allowing or causing the resin composition to cure to provide a pond having a solid polymer liner thereon.

13. A method according to claim 12 including any of the features of claims 3 to 11.

14. A receptacle for containing a liquid, the receptacle including one or more interior or inwardly facing surfaces having thereon a liner comprising a spray-coated polymeric

layer.

15. A receptacle according to claim 14 which is a pond.

16. A receptacle according to claim 15 wherein the pond includes one or more vent pipes located in a base position of the pond, wherein a joint between the base portion and the one or more vent pipes is sealed by the polymer composition.

17. A receptacle according to any one of claims 14 to 16 wherein the polymer composition is a polyurethane.

18. A receptacle according to claim 17 wherein the polymer composition is formed from a liquid polymer resin, the liquid polymer resin including a polyol component and an isocyanate component.

19. A receptacle according to claim 18 wherein the liquid polymer resin further includes a catalyst.

20. A receptacle according to claim 18 or claim 19 wherein the polyol component includes at least one polyether polyol.

21. A receptacle system including any of the features of claims 14 to 20 and one or more of:

- a filtration apparatus,
- one or more pumps,
- one or more conduits, and
- purification apparatus.

22. A use of a liquid polymer resin composition in the manufacture of a receptacle capable of containing a liquid, wherein the liquid resin composition is applied to the



interior surfaces of the receptacle and allowed or caused to cure to provide a receptacle having an interior polymer lining.

23. A use according to claim 22 wherein the liquid resin composition is applied to the receptacle by spray coating.

24. A use according to either claim 22 or claim 23 wherein the receptacle is a pond for containing water.

25. A use according to any one of claims 22 to 24 wherein the liquid resin composition is as defined in any one of claims 18 to 20.

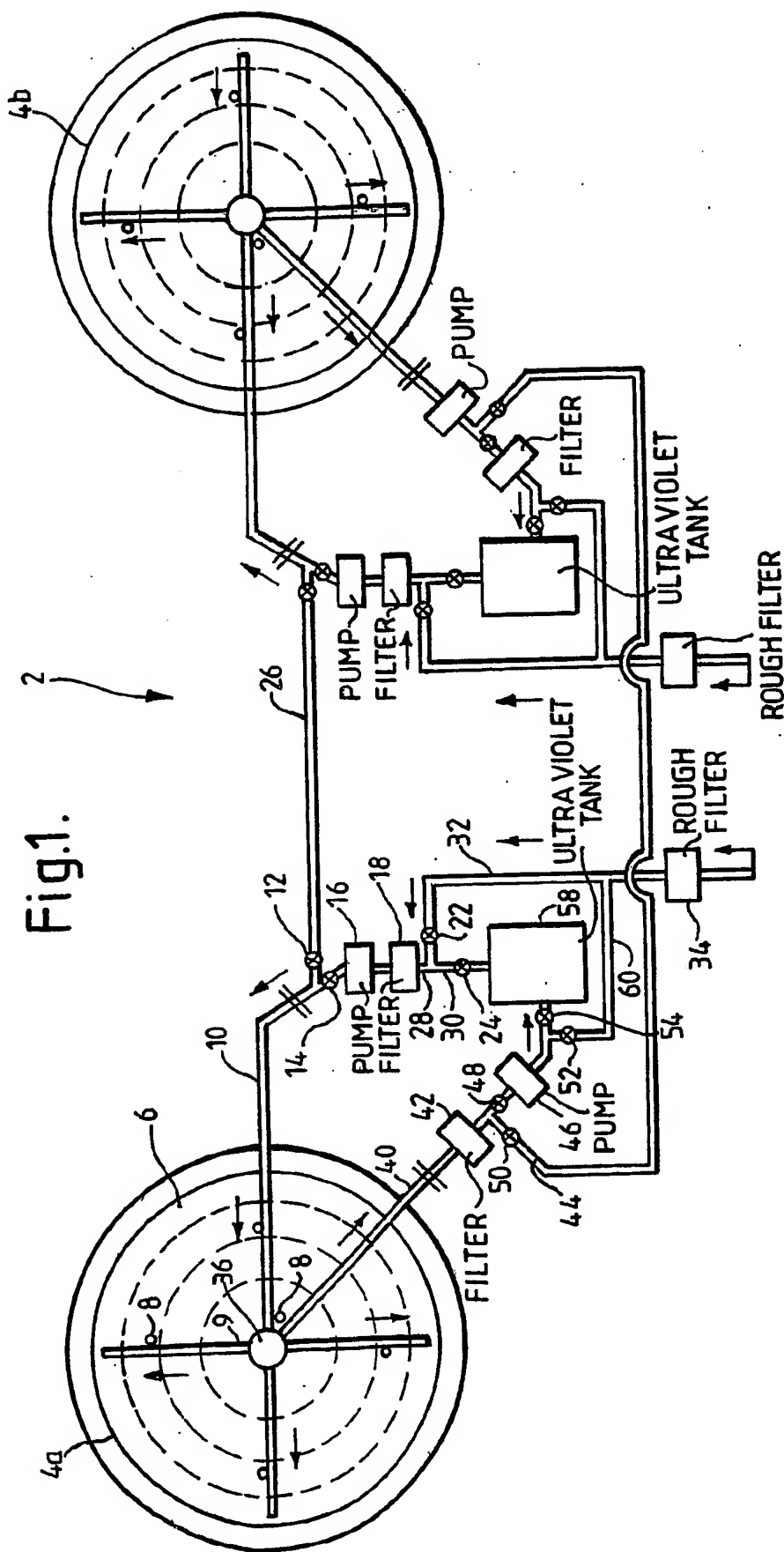
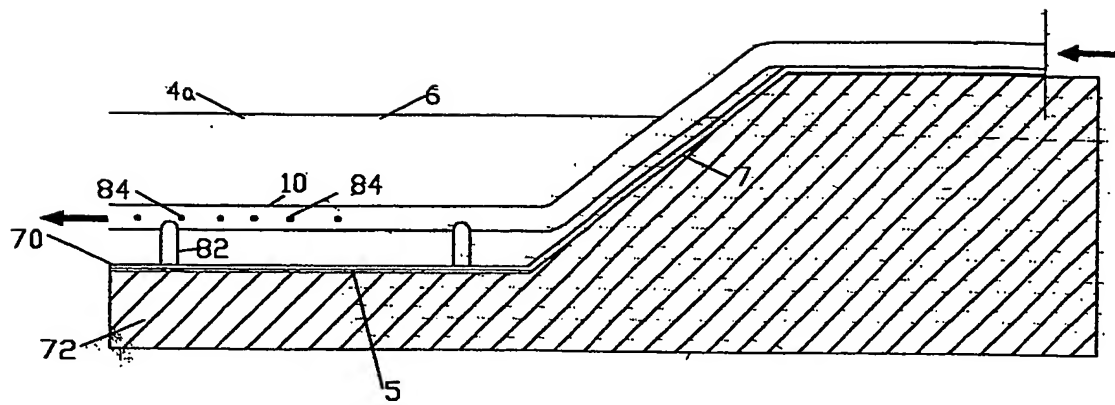
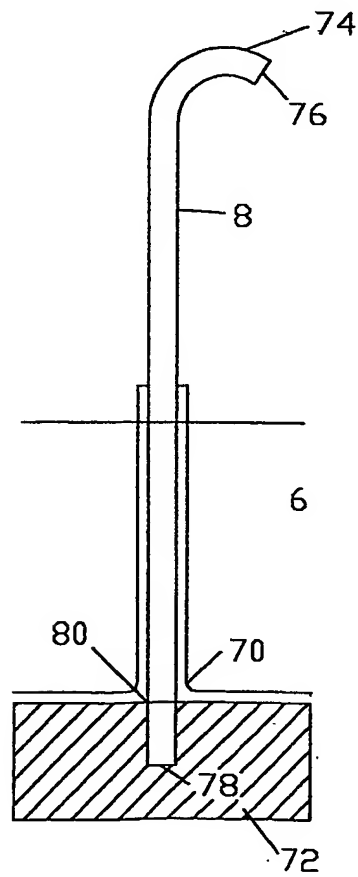


Fig.1.



**FIG 2**



**FIG 3**

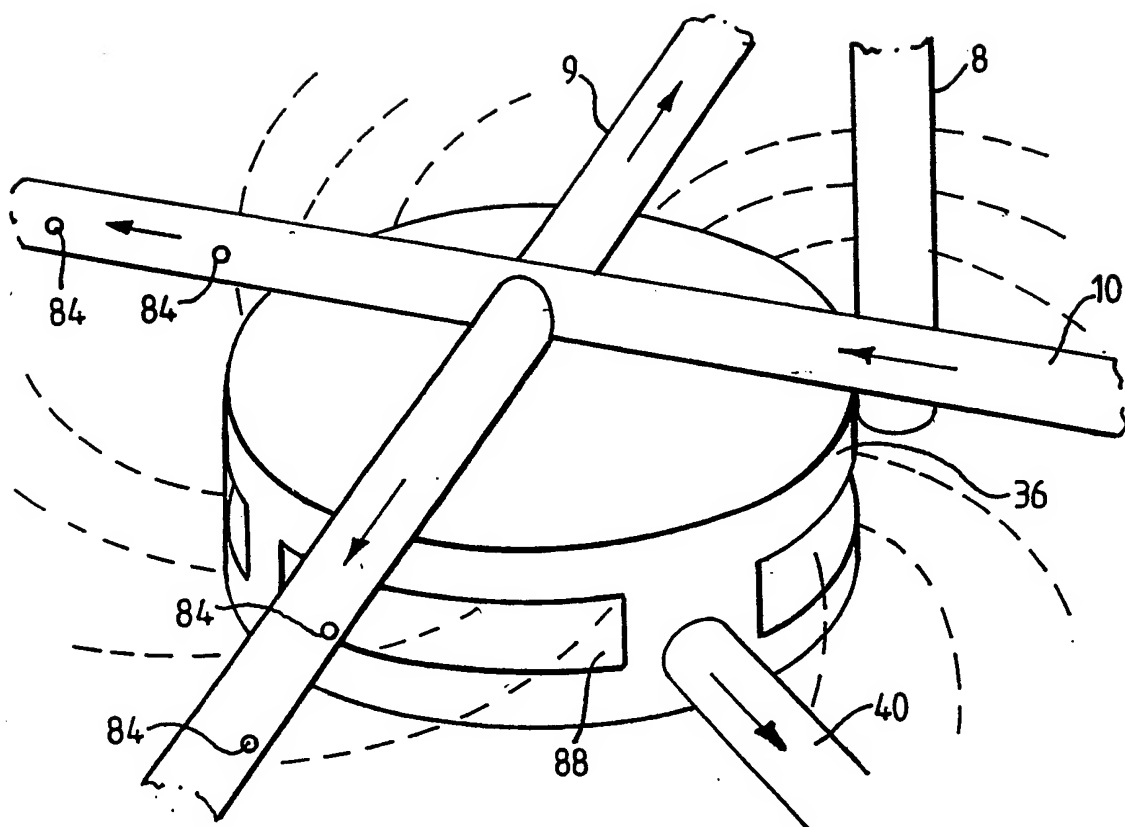


Fig. 4.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/04991

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 A01K63/00 E02D31/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A01K B09C B09B E02D E02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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Y	column 1, line 20 - line 22 column 2, line 65 - column 3, line 41	5-8, 16, 21
X	US 5 415 499 A (HOVRAS YEARA ET AL) 16 May 1995 (1995-05-16)  column 2, line 54 - line 62 column 3, line 30 - line 61; figure 2  -/-	1-4, 9, 11, 14, 15, 17-20, 22-25



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

11 July 2002

Date of mailing of the international search report

18/07/2002

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European Patent Office, P.B. 5818 Patentlaan 2  
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# INTERNATIONAL SEARCH REPORT

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